CLAIMS

1. A picture angle detection apparatus for detecting an angle of a picture related to a pixel to be interpolated in each interpolation scanning line between scanning lines based on an input video signal, comprising:

a binary pattern generater that binarizes said input video signal in a predetermined detection region including a plurality of scanning lines and said pixel to be interpolated to generate a binary pattern;

a reference pattern generater that generates binary pictures having different directions as a plurality of reference patterns;

a comparator that compares the binary pattern generated by said binary pattern generater with each of the plurality of reference patterns generated by said reference pattern generater to detect the angle of the picture related to said pixel to be interpolated based on a comparison result; and

a shape detector that detects the shape of the picture based on a combination of the angle of the picture detected by said comparator related to said pixel to be interpolated and angles of the picture detected in upper and lower interpolation scanning lines.

2. The picture angle detection apparatus according to

claim 1, wherein

provided that the angle of the picture detected by said comparator related to said pixel to be interpolated is between the angle of the picture detected in the upper interpolation

5   scanning line and the angle of the picture detected in the lower interpolation scanning line, and the absolute value of the angle of the picture detected in the upper interpolation scanning line is larger than the absolute value of the angle of the picture detected in the lower interpolation scanning

10 line,

said shape detector outputs a shape detection signal indicating that the shape of the picture is convex toward the lower right, when the angle of the picture detected related to said pixel to be interpolated, and the angle of the picture

15 detected in the upper interpolation scanning line and the angle of the picture detected in the lower interpolation scanning line are positive values, and said shape detector outputs a shape detection signal indicating that the shape of the picture is convex toward the lower left, when the angle of the picture

20 detected related to said pixel to be interpolated, and the angle of the picture detected in the upper interpolation scanning line and the angle of the picture detected in the lower interpolation scanning line are negative values, and

provided that the angle of the picture detected by said

25 comparator related to said pixel to be interpolated is between

the angle of the picture detected in the upper interpolation scanning line and the angle of the picture detected in the lower interpolation scanning line, and the absolute value of the angle of the picture detected in the upper interpolation

5   scanning line is smaller than the absolute value of the angle of the picture detected in the lower interpolation scanning line,

said shape detector outputs a shape detection signal indicating that the shape of the picture is convex toward the

10   upper left, when the angle of the picture detected related to said pixel to be interpolated, and the angle of the picture detected in the upper interpolation scanning line and the angle of the picture detected in the lower interpolation scanning line are positive values, and said shape detector outputs a

15   shape detection signal indicating that the shape of the picture is convex toward the upper right, when the angle of the picture detected related to said pixel to be interpolated, and the angle of the picture detected in the upper interpolation scanning line and the angle of the picture detected in the lower

20   interpolation scanning line are negative values.

3. The picture angle detection apparatus according to claim 1, wherein

when said shape detector detects that the shape of the

25   picture is an arc, said detector outputs a shape detection

signal indicating the direction of the inside of the arc.

4. The picture angle detection apparatus according to claim 1, wherein

said binary pattern generater comprises:

a threshold value calculation device that calculates a threshold value for binarization based on the luminance of a video signal in said detection region; and

a binarizer that binarizes said input video signal using the threshold value calculated by said threshold value calculation device to generate said binary pattern.

5 The picture angle detection apparatus according to claim 1, further comprising a determining device that determines whether or not the luminance distribution in the horizontal direction of each scanning line is in the form of a monotonous increase or a monotonous decrease in the video signal in said detection region, wherein

said comparator does not compare said binary pattern with each of said plurality of reference patterns when said luminance distribution is neither in the form of a monotonous increase nor a monotonous decrease.

6. The picture angle detection apparatus according to

claim 1, further comprising a contrast detector that detects a contrast in a video signal in said detection region, wherein

said comparator does not compare said binary pattern with each of said plurality of reference patterns when the contrast

5 detected by said contrast detector is smaller than a predetermined value.

7. The picture angle detection apparatus according to

10 claim 1, wherein

the plurality of reference patterns each include a first pixel row arranged in a scanning line above said pixel to be interpolated and a second pixel row arranged in a scanning line below said pixel to be interpolated,

15 said first pixel row has one transition point from a first pixel value to a second pixel value, said second pixel row has one transition point from a first pixel value to a second pixel value, and the transition direction from the first pixel value to the second pixel value in said first pixel row and the

20 transition direction from the first pixel value to the second pixel value in the second pixel row are the same.

8. A scanning lines interpolation apparatus, comprising:

25 a picture angle detection apparatus that detects the

angle and shape of a picture related to a pixel to be interpolated based on an input video signal; and

an interpolation circuit that selects pixels to be used for interpolation based on the angle and shape detected by said

5 picture angle detection apparatus, and calculates the value of said pixel to be interpolated using the selected pixels to generate an interpolation scanning line,

said picture angle detection apparatus including:

a binary pattern generater that binarizes said input

10 video signal in a predetermined detection region including a plurality of scanning lines and said pixel to be interpolated in each said scanning line to generate a binary pattern;

a reference pattern generater that generates binary pictures having different directions as a plurality of

15 reference patterns;

a comparator that compares the binary pattern generated by said binary pattern generater with each of the plurality of reference patterns generated by said reference pattern generater to detect the angle of the picture related to said

20 pixel to be interpolated based on a result of comparison; and

a shape detector that detects the shape of the picture based on a combination of the angle of the picture detected by said comparator related to said pixel to be interpolated and angles of the picture detected in upper and lower

25 interpolation scanning lines.

9. The scanning lines interpolation apparatus according to claim 8, wherein

when said shape detector detects that the shape of the

5 picture is an arc, said detector outputs a shape detection signal indicating the direction of the inside of the arc, and

said interpolation circuit selects pixels to be used for interpolation from the inside of the arc based on the shape detection signal output from the shape detector and calculates

10 the value of said pixel to be interpolated using the selected pixels to generate an interpolation scanning line.

10. The scanning lines interpolation apparatus according to claim 8, wherein

15 when said shape detector detects that the shape of the picture is an arc, said detector outputs a shape detection signal indicating the direction of the inside of the arc, and

said interpolation circuit selects positions shifted in the direction of the inside of the arc by 0.5 pixel from

20 positions in the upper and lower scanning lines in the direction of the angle of the picture detected for the pixel to be interpolated and calculates the value of said pixel to be interpolated using the values of the pixels in the selected positions.

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11. A picture angle detection methods for detecting an angle of a picture related to a pixel to be interpolated in each interpolation scanning line between scanning lines based on an input video signal, comprising the steps of:

5   binarizing said input video signal in a predetermined detection region including a plurality of scanning lines and said pixel to be interpolated to generate a binary pattern;

generating binary pictures having different directions as a plurality of reference patterns;

10   comparing said generated binary pattern with each of said generated plurality of reference patterns to detect the angle of the picture related to said pixel to be interpolated based on a comparison result; and

detecting the shape of the picture based on a combination

15 of the angle of said detected picture related to said pixel to be interpolated and angles of the picture detected in upper and lower interpolation scanning lines.